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REPORT



Reliability and relationship of the fear-avoidance beliefs questionnaire with the shoulder pain and disability index and numeric pain rating scale in patients with shoulder pain

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ABSTRACT

Purpose: The purpose of this study was to determine: 1) the test-retest reliability of Fear-Avoidance Beliefs Questionnaire (FABQ) Work (FABQW) subscale, FABQ Physical Activity (FABQPA) subscale, Shoulder Pain and Disability Index (SPADI) Pain subscale, SPADI Disability subscale, and Numeric Pain Rating scale (NPRS); and 2) the relationship between the FABQPA, FABQW, SPADI pain, SPADI disability, and NPRS after 4 weeks of pragmatically applied physical therapy (PT) in patients with shoulder pain. **Design:** Prospective, single-group observational design. **Methods:** Data were collected at initial evaluation, the first follow-up visit prior to the initiation of treatment, and after 4 weeks of treatment. **Results:** Statistically significant Intraclass Correlation Coefficient (ICC_{2,1}) values were reported for the FABQPA, FABQW, SPADI Pain, SPADI Disability, and NPRS. A statistically significant moderate relationship between the FABQPA subscale, SPADI subscale, and NPRS could not be established prior to and after 4 weeks of pragmatically applied PT. Statistically significant differences were observed between the initial evaluation and four-week follow-up for the FABQPA, SPADI Pain, SPADI Disability, and NPRS ($p < 0.01$). **Discussion:** Since a meaningful relationship between the FABQ, SPADI, and NPRS did not exist, it suggests that the FABQPA may be measuring a metric other than pain. **Conclusions:** This study suggests that the FABQW may not be sensitive to change over time.

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KEYWORDS

Avoidance learning; fear;
shoulder; shoulder pain;
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Background

The Fear-Avoidance Beliefs Questionnaire (FABQ) is one of the most utilized and studied measures of fear avoidance beliefs and behaviors (Lundberg, Grimby-Ekman, Verbunt, and Simmonds, 2011). The FABQ was originally designed to assess and treat patients with chronic low-back pain related to fear avoidance beliefs (Waddell et al., 1993). The FABQ has since been deemed valid for use in patients suffering from both acute and chronic low-back pain (George, Fritz, and McNeil, 2006) as well as for use in multiple body regions to include the cervical spine, upper extremities, lumbar spine, and lower extremities (George and Stryker, 2011). Modifying the FABQ for use with patients suffering from shoulder pain has been shown to correlate with the Shoulder Pain and Disability Index (SPADI) and has been suggested as an adjunct determinant of short-term disability (Mintken, Cleland, Whitman, and George, 2010). The test-retest reliability of the Fear-

Avoidance Beliefs Questionnaire Physical Activity (FABQPA) subscale in shoulder patients was found to be excellent Intraclass Correlation Coefficient (ICC = 0.88, 95% confidence interval (CI) of 0.75–0.93) (Mintken, Cleland, Whitman, and George, 2010). In addition, Mintken, Cleland, Whitman, and George (2010) found that the FABQPA was the greatest contributor to the SPADI Disability subscale score and accounted for 11% of the variance in the SPADI Disability subscales. Replication of these preliminary findings to determine their generalizability across patient populations with shoulder pain to our knowledge has not been attempted. Pain-related fear avoidance behavior might arise from several potential factors that are not assessed with the FABQ (Pincus, Smeets, Simmonds, and Sullivan, 2010; Rainville et al., 2011). These include fear of increased pain, fear of injury or re-injury, or secondary pain experienced when performing any activity in the absence of any fear of movement (Pincus, Smeets, Simmonds, and

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Sullivan, 2010; Rainville et al., 2011). Additionally, the FABQ does not provide the clinician with any cutoff scores to help make clinical decisions (Lundberg, Grimby-Ekman, Verbunt, and Simmonds, 2011).

Although fear avoidance beliefs as measured by the FABQ have been shown to correlate with the SPADI Pain and Disability scores (Mintken, Cleland, Whitman, and George, 2010), what the FABQ is measuring has not been determined. If the FABQ Physical Activity (FABQPA) and FABQ Work (FABQW) subscales are related to the SPADI Pain and Disability scales (Mintken, Cleland, Whitman, and George, 2010) and if the SPADI Pain and Disability scales have been shown to be correlated to the Numeric Pain Rating scale (NPRS; Riley et al., 2015), it is quite possible that the FABQ is a measure of pain in the absence of fear (Pincus, Smeets, Simmonds, and Sullivan, 2010; Rainville et al., 2011). Our a-priori hypothesis was that decreased patient shoulder pain on the NPRS would correlate with decreases in the SPADI and FABQ subscales. The purpose of this study was to determine: 1) the test-retest reliability of FABQW subscale, FABQPA subscale, SPADI Pain subscale, SPADI Disability subscale, and NPRS; 2) the relationship between the FABQPA subscale, FABQW subscale, SPADI Pain subscale, SPADI Disability subscale, and NPRS at the initial evaluation and at 4 weeks after pragmatically applied physical therapy (PT) to the shoulder; and 3) if the FABQW subscale, FABQPA subscale, SPADI Pain subscale, SPADI Disability subscale, and NPRS change in response to pragmatically applied PT over 4 weeks.

Methods

Study design

This study was a prospective, single-group (cohort) observational design study. This study was a planned secondary analysis of data collected for the establishment of a new physical performance measure for the shoulder in the open kinetic chain. The purpose of the original study was to determine if this new measure was reliable, related to established measures of shoulder function, and able to detect change over time that was observed with these established measures of shoulder function. The PT management in this study was pragmatically applied and included manual therapy directed at the glenohumeral joint and surrounding structures consistent with the regionally interdependent model. In addition, scapular strength and stabilization exercises focusing on the middle and lower trapezius and rotator cuff strength and stabilization exercises were performed. Therapeutic interventions were pragmatic in nature and were provided to

patients based on their symptomatic response to treatment within and between treatment sessions.

Setting

The subjects for this study were patients that presented to the hospital-based Outpatient Department of Rehabilitation at UConn Health in Farmington, Connecticut, for consultation related to complaints of shoulder pain. Patients were recruited based on the approved recruiting period from the UConn Health IRB (IRB Number: 15-144-1) from April 23, 2015 to April 22, 2016. Data were collected at the initial evaluation, the first follow-up visit prior to the initiation of treatment, and after 4 weeks of pragmatically applied PT.

Participants

Patients were consecutively screened and consented by one of the two licensed physical therapists with more than 12 years of clinical practice in musculoskeletal management. Shoulder pain was defined as shoulder symptoms $\geq 2/10$ or $\leq 8/10$ at the time of testing on the NPRS with active shoulder elevation in the patient's preferred movement pattern. The patients were not provided with home exercises between their first and second PT visits. The patients were asked to continue their normal everyday activities of daily living if they did not aggravate their symptoms. No vulnerable patient populations were included in this study.

Inclusion criteria

Since the patients' contralateral shoulder was being used as a control in the original study, the patients had to report unilateral shoulder pain at the time of the evaluation. In addition, they had to be 18 years of age or older and be willing to participate in 4 weeks of pragmatic treatment for their shoulder.

Exclusion criteria

Patients were excluded from the study if they had signs and symptoms consistent with shoulder symptoms secondary to cervical pathology, which included: 1) positive cervical distraction test (Boyles et al., 2009); 2) positive Spurling's test (Boyles et al., 2009); 3) positive Hoffmann's test; 4) inverted supinator reflex (Cook et al., 2009); 5) positive Babinski sign; 6) positive deep tendon reflexes of the upper extremity; 7) positive deep tendon reflexes of the lower extremity; 8) greater than three beats of clonus at the foot and ankle; and 9) positive cog wheeling with rapid alternating movements of elbow flexion and extension at the upper extremity. In addition, patients were excluded if they

had a history of shoulder surgery, had PT treatment to the shoulder within the last 3 months, had any needle injection to the shoulder in the last month, and had pain less than 2/10 or greater than 8/10 at the time of testing.

Length of subject's participation in the study

This study required the patients to report to the clinic consistent with the number of visits required for pragmatic PT treatment of their shoulder symptoms. The typical duration and frequency within the department is 2–3 times a week for 4 to 6 weeks. Duration of each session was approximately 30–45 minutes. Data were collected at the initial evaluation, at the first follow-up visit prior to the initiation of treatment, and at 4-week follow-up visits.

Variables. The outcome measures for this study were subjective in nature and recorded prior to any portion of the physical exam. The ordering of the subjective variables of interest for this study was NPRS (at the time of testing), SPADI, and FABQPA and FABQW subscales.

Fear-Avoidance Beliefs Questionnaire (FABQ)

The FABQ is a self-reported questionnaire consisting of 16 questions on a scale from 0 to 6. The physical activity subscale (FABQPA, range: 0–24) is the sum of items 2–5. The work subscale (FABQW, range: 0–42) is the sum of items 6, 7, 9–12, and 15. Items 1, 8, 13, 14, and 16 are distractor questions that do not contribute to either subscale (Waddell et al., 1993). Although the FABQ has been reported as a total score in the literature, it was designed to be scored this way (Waddell et al., 1993). The FABQPA subscale test–retest reliability has been reported to have an ICC value of 0.88 with a 95% CI of 0.75–0.93 for subjects with shoulder pain (Mintken, Cleland, Whitman, and George, 2010). The minimally detectable change for workers with an upper extremity injury has been reported to be a 30–33% change for both of the subscales (Inrig, Amey, Borthwick, and Beaton, 2012).

Shoulder Pain and Disability Index (SPADI)

The SPADI has 13 items. Five of the items target pain and eight of them target the subject's disability. The domains the SPADI measures include pain, mobility, and self-care. The scales are 10-point ordinal scales that are contained within the SPADI and scored as a percentage with a higher percentage score indicating greater pain and disability (Staples, Forbes, Green, and Buchbinder, 2010). The SPADI has demonstrated test–retest reliability with ICC values of 0.57–0.84 (Bot et al.,

2004). The minimal detectable change for the SPADI has been reported to be between 17 and 21.5 (Roddey et al., 2000; Tveita, Ekeberg, Juel, and Bautz-Holter, 2008) and the minimally clinically important difference of 8–15.4 (Ekeberg et al., 2008; Paul et al., 2004).

Numeric Pain Rating scale (NPRS)

The NPRS is an 11-point ordinal system, which is a scale between 0 and 10, where 0 represents no pain and 10 represents pain as bad as it can be. Test–retest reliability of the NPRS has been reported to be between 0.67 and 0.96 (Ferraz et al., 1990; Jensen, Karoly, and Braver, 1986; Jensen, Turner, Romano, and Fisher, 1999; Stratford and Spadoni, 2001).

Data sources/measurement. The subjects were the source of data for the FABQPA and FABQW subscales, the SPADI Pain and Disability subscales, and the NPRS.

Bias. To help control for bias, one of the two researchers entered the room and collected the outcome measures of interest. The clinician that entered the room first was determined by whom the patient was scheduled with for their initial evaluation. The researchers had no control over or knowledge related to how the patients were scheduled and scheduling was performed by the front office who had no knowledge of the methods of the research study. At the next follow-up visit, the same procedure was followed, except that the researcher that collected the outcome measures first was now second to collect measurements. The two researchers were blinded to each other's outcome measures and their findings were given to a third researcher to ensure blinding and maintenance of the data. Whoever was the primary clinician at the first PT visit collected the data at the 4-week follow-up visit.

Study size. Given that this study was a planned secondary analysis, a post-hoc power analysis calculation was performed to determine the sample size required for the study using the FABQPA as the primary outcome measure and utilizing a paired *t*-test. The physical activity subscale was chosen secondary to the a-priori belief that the physical activity subscale of the FABQ may be related to the SPADI Disability scales and the SPADI Disability scale would be related to the NPRS. The study was designed with the α value set at .05 (type I error) and β value set at 0.2 (type II error). The sample size was calculated based on the observed detectable difference of 5.6 with a standard deviation of 6.7 for the FABQPA between the initial evaluation and the 4-week follow-up. It was determined that 14

subjects would be required to ensure that the study was appropriately powered.

Statistical methods

Descriptive statistics (means, standard deviations, and minimum and maximum values) were carried out for the subjects' characteristics, including age, gender, symptomatic shoulder, duration of the shoulder symptoms. The Shapiro–Wilk test was used to determine if the data were normally distributed. If the data were normally distributed and met the parametric assumptions, parametric statistical testing would be utilized. If not, the nonparametric equivalent of each test would be used as described below.

The $ICC_{2,1}$ was utilized to determine the test–retest reliability of the variables of interest. This model was chosen secondary to the subjects being measured by each rater and the reliability was to be calculated by a single measure. Shoulder symptoms in this sample were determined to be chronic in a previously published study (Riley et al., 2015), which is defined as pain that lasted for more than 3–6 months on average (Treede et al., 2015). It was therefore anticipated that there would be no improvements in the patient's condition between the initial evaluation and the first follow-up visit prior to the initiation of treatment secondary to the passage of time. The $ICC_{2,1}$ with the corresponding 95% CIs were therefore necessary to verify that the patients' shoulder symptoms were stable and not highly variable prior to the initiation of treatment.

To determine if the FABQ, SPADI, and NPRS could detect changes between the initial evaluation and the 4-week follow-up, the paired samples *t*-test was utilized for the FABQ, SPADI, and NPRS if the data met the parametric assumptions and the Wilcoxon signed ranks test was utilized if the data did not meet the parametric assumptions.

To determine if the potential changes in the FABQ, SPADI and NPRS between the initial evaluation and the first follow-up visit prior to the initiation of treatment were associated, the Pearson's *r* was to be used if the data met the parametric assumptions and Spearman's rho would be used if the data were nonparametric. For the purpose of this study, statistically significant correlations had to be at least moderate at a level of 0.50 to be considered meaningful (Mukaka, 2012).

Inferential statistics were conducted to answer the research questions and missing data were handled by utilizing the automatic multiple imputations feature in SPSS version 23 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. IBM Corp., Armonk, NY). If the calculations from the pooled data

from the multiple imputations were not different than the output of the calculations utilizing the original data, the statistical analyses were compared and verified utilizing MedCalc for Windows, version 16.4.3 (MedCalc Software, Ostend, Belgium) and the original data were reported to retain the standard deviations that are lost with calculations utilizing pooled data from multiple imputations.

Results

Participants

Two hundred and six patients with non-post-surgical shoulder pain were screened for eligibility from May 8, 2015 to April 19, 2016 (Figure 1). Fifty-four patients were excluded from the study following the intake questionnaire and one hundred and twelve were excluded by the clinical exam. This left 38 subjects that agreed to participate and signed informed consent. Two subjects were lost to follow-up after the first visit and six subjects were lost to follow-up after the second visit. This left a total of 30 subjects at the 4-week follow-up.

Descriptive data

A total of 24 women and 14 men with an average age of 48.1 ± 15.6 years and average symptom duration of 5.3 ± 9.7 months completed the study. Baseline demographics are provided in Table 1. Of the 38 subjects that enrolled the study, 13 had symptomatic left shoulder and 25 subjects had symptomatic right shoulder.

Main results

The Shapiro–Wilk test determined that the data for the FABQ were not normally distributed. Nonparametric statistical analyses were therefore utilized. Statistically significant $ICC_{2,1}$ values were found for the FABQPA, FABQW, SPADI Pain, SPADI Disability, and NPRS (Table 2). These $ICC_{2,1}$ values were 0.43 (–0.12–0.71) for the FABQPA, 0.95 (0.91–0.98) for the FABQW, 0.94 (0.88–0.97) for the SPADI Pain subscale, 0.92 (0.84–0.96) for the SPADI Disability subscale, and 0.88 (0.77–0.94) for the NPRS.

Statistically significant differences were observed between the initial evaluation and 4-week follow-up for the FABQPA, SPADI Pain, SPADI Disability, and NPRS ($p < 0.01$; Table 3). There were no statistically significant findings between the initial evaluation and 4-week follow-up on the FABQW ($p = 0.70$).

At the initial evaluation, statistically significant correlations were observed between the FABQPA, SPADI Pain, and SPADI Disability scales, which were $r_s = 0.45$,

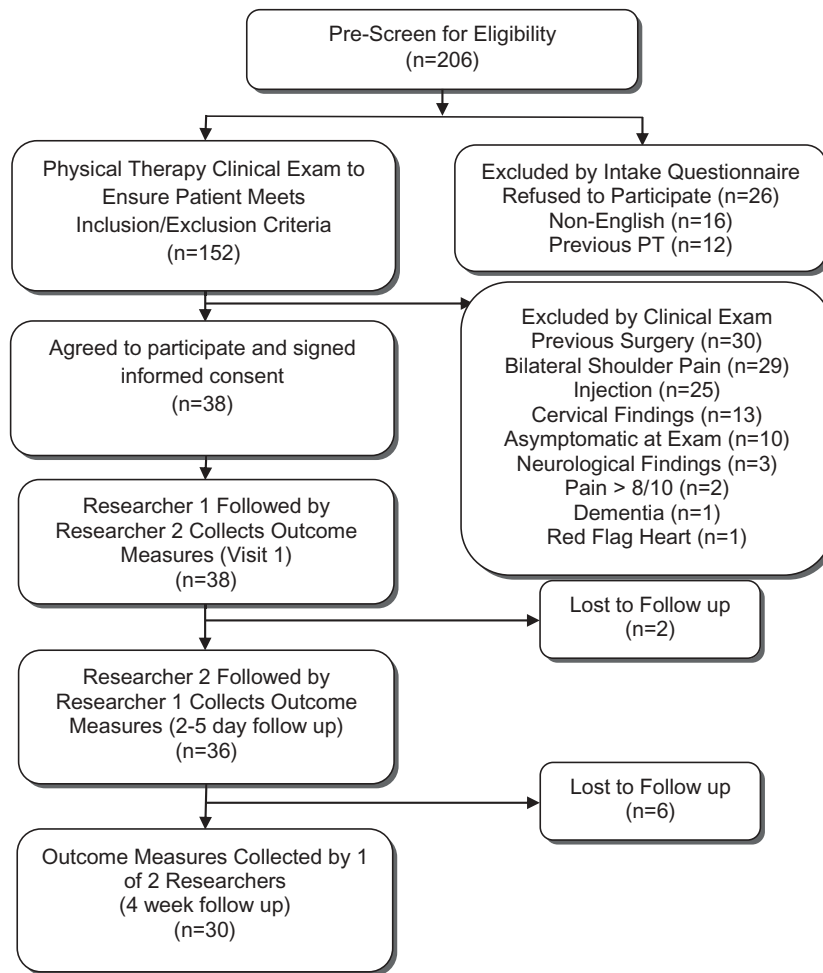


Figure 1. Flow of the study.

Table 1. Baseline demographics*.

Variables	Total sample (n = 38)
Age (years)	48.1 ± 15.6
Symptomatic shoulders (right)	25 (64.1%)
Sex (female)	24 (61.5%)
Symptoms duration (months)	5.3 ± 9.7

*Data are means ± standard deviations unless denoted otherwise.

Table 2. Test-retest reliability of the FABQPA, FABQW, SPADI Pain, SPADI Disability, and NPRS for symptomatic shoulders (n = 38).

Item/Subscale	ICC _{2,1}	95% CI	p-Value
FABQPA	0.43	−0.12–0.71	p = 0.05
FABQW	0.95	0.91–0.98	p < 0.01
SPADI Pain	0.94	0.88–0.97	p < 0.01
SPADI Disability	0.92	0.84–0.96	p < 0.01
NPRS	0.88	0.77–0.94	p < 0.01

FABQPA: Fear-Avoidance Belief Questionnaire Physical Activity subscale; FABQW: Fear-Avoidance Belief Questionnaire Work subscale; SPADI Pain: Shoulder Pain and Disability Index Pain subscale; SPADI Disability: Shoulder Pain and Disability Index Disability subscale; NPRS: Numerical Pain Rating scale.

p < 0.01 and $r_s = 0.37$, p = 0.02, respectively (Table 4). At the 4-week follow-up, statistically significant correlations were observed between the FABQPA, SPADI

Table 3. Differences for symptomatic shoulders between initial evaluation and 4-week follow-up for outcome measures of interest with original data (n = 38).

Item/follow-up	Initial evaluation* (n = 38)	Four-week follow-up* (n = 30)	p-Values [†]
FABQPA	16.0 ± 4.4	10.4 ± 6.7	p < 0.01
FABQW	7.5 ± 8.7	4.8 ± 6.4	p = 0.70
SPADI Pain	54.2 ± 20.5	30.4 ± 18.8	p < 0.01
SPADI Disability	41.0 ± 23.7	20.0 ± 18.2	p < 0.01
NPRS	3.6 ± 2.5	1.5 ± 1.7	p < 0.01

FABQPA: Fear-Avoidance Belief Questionnaire Physical Activity subscale; FABQW: Fear-Avoidance Belief Questionnaire Work subscale; SPADI Pain: Shoulder Pain and Disability Index Pain subscale; SPADI Disability: Shoulder Pain and Disability Index Disability subscale; NPRS: Numerical Pain Rating scale.

*Data are means and standard deviations.

[†]Wilcoxon signed ranks test.

Pain and SPADI Disability subscales, and NPRS, which were $r_s = 0.42$, p = 0.02, $r_s = 0.44$, p = 0.02, and $r_s = 0.45$, p = 0.02, respectively (Table 4). In addition, a statistically significant correlation was observed between the FABQPA and NPRS and the FABQW and NPRS at the 4-week follow-up, which were $r_s = 0.45$, p = 0.02 and $r_s = 0.50$, p < 0.01, respectively (Table 4).

Table 4. Correlations at initial evaluation and 4-week follow-up between the FABQPA and SPADI subscales ($n = 38$).

Correlations at initial evaluation	FABQPA* ($n = 38$)	FABQW* ($n = 38$)	Correlations at 4-week follow-up	FABQPA* ($n = 30$)	FABQW* ($n = 30$)
FABQW	0.19 ($p = 0.25$)		FABQW	0.18 ($p = 0.35$)	
SPADI Pain	0.45 ($p < 0.01$)	0.08 ($p = 0.64$)	SPADI Pain	0.42 ($p = 0.02$)	0.35 ($p = 0.06$)
SPADI Disability	0.37 ($p = 0.02$)	0.10 ($p = 0.57$)	SPADI Disability	0.44 ($p = 0.02$)	0.30 ($p = 0.11$)
NPRS	0.12 ($p = 0.49$)	0.08 ($p = 0.64$)	NPRS	0.45 ($p = 0.02$)	0.50** ($p < 0.01$)

FABQPA: Fear-Avoidance Belief Questionnaire Pain Physical Activity subscale; FABQW: Fear-Avoidance Belief Questionnaire Work subscale; SPADI Pain: Shoulder Pain and Disability Index Pain subscale; SPADI Disability: Shoulder Pain and Disability Index subscale; NPRS: Numerical Pain Rating scale.

*Spearman correlation.

**Statistically significant moderate correlations ≥ 0.50 .

The only statistically significant relationship that reached the previously defined level of a moderate relationship was between the NPRS and the FABQW at 4 weeks.

Discussion

If a relationship between the NPRS, SPADI, and FABQ subscales could have been established, it may have questioned the construct validity of the FABQ. In this study, the FABQW, SPADI Pain, SPADI Disability, and NPRS demonstrated statistically significant ICC_{2,1} values greater than 0.87 with almost perfect agreement and narrow 95% CIs. This suggests that these measures have excellent test–retest reliability and that they were measuring a stable phenomenon over time.

At initial evaluation, statistically significant correlations were observed between the FABQPA and the SPADI Pain ($\rho = 0.45$) and the SPADI Disability ($\rho = 0.37$) scales. None of these relationships were moderate ($\rho \geq 0.50$). At the 4-week follow-up visit, the relationships between FABQPA and the SPADI subscales were similar to the initial visit (SPADI Pain, $\rho = 0.42$ and SPADI Disability, $\rho = 0.44$). Again, none of these relationships was moderate ($\rho \geq 0.50$).

At the initial visit, the FABQPA and NPRS did not demonstrate a statistically significant relationship ($\rho = 0.12$); however, statistically significant correlations were observed between the FABQPA and NPRS ($\rho = 0.45$) and the FABQW and NPRS ($\rho = 0.5$) at the 4-week follow-up. The only statistically significant relationship that reached the previously defined moderate level was the relationship between the NPRS and the FABQW at 4 weeks. This suggests that the FABQPA and NPRS are not moderately related. Since a meaningful relationship between the FABQ, SPADI, and NPRS did not exist, it suggests that the FABQPA may be measuring a metric other than pain.

Key results

The FABQW, SPADI Pain, SPADI Disability, and NPRS were shown to have excellent test–retest reliability and therefore appeared to be measuring a stable condition

over time. A meaningful relationship between these measures did not exist, suggesting that the FABQPA may be measuring a metric other than pain. In the context of shoulder pain, fear avoidance behavior related to activity, function related to the SPADI, and pain as measured by the NPRS may improve without any improvement in fear avoidance related to work.

Limitations

This was a small study that was established with the primary intent of establishing the basic psychometric properties of a new physical performance test in the open kinetic chain for the shoulder. Although this study was appropriately powered for this planned secondary analysis, its design should be repeated with larger numbers to determine if our findings are generalizable.

Generalizability

Our findings are only generalizable to the subgroup of patients that we evaluated. Future trials should attempt to determine if these findings are reproducible in younger, more acute patients as well as patients with a previous history of shoulder surgery.

Conclusion

The results of this study indicated that the FABQPA and SPADI subscales and NPRS displayed excellent test–retest reliability when measured on two separate visits in patients with shoulder pain. Additionally, these outcome measures displayed little to fair correlations between each other, suggesting that they are measuring somewhat different metric in patients with shoulder pain and are appropriate for clinical use. Finally, although FABQPA and SPADI subscales and NPRS significantly improved in patients with shoulder pain over a 4-week period, the FABQW did not improve in patients with shoulder symptoms.

Declaration of Interest

The authors report no conflicts of interest.

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